

Sarah Kaakai

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Current Position

09/24 - Maitre de Conférence, [LAGA](#), University Sorbonne Paris Nord.

Research Areas

My research focuses on stochastic processes and nonparametric inference, applied to problems arising from biology, ecology, and demography, as well as stochastic control and numerical probability:

- Age-structured stochastic population dynamics,
- Modeling of biological aging mechanisms,
- Demographic risks and pension design,
- Stochastic control and numerical probability.

Experience and Education

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| 09/23 - 08/24
2023 | Visiting researcher , Center for Applied Mathematics , École Polytechnique, ERC project SINGER.
Maternity leave. |
| 2018-2024 | Associate Professor , Le Mans Mathematics Laboratory, Le Mans University. |
| 01/22-06/22 | Visiting Researcher Interdisciplinary Research Center, Paris . |
| 01/18- 09/18 | Postdoctoral Researcher , Center for Applied Mathematics , École Polytechnique.
Postdoctoral fellowship from the Jacques Hadamard Mathematical Foundation . |
| 2014- dec 17 | PhD in Applied Mathematics , LPSM , Sorbonne University, supervised by Nicole El Karoui.
<ul style="list-style-type: none"> ◦ <i>Title</i>: New paradigms in heterogeneous population dynamics: Pathwise modeling, Aggregation, and Empirical data. |
| 2012-13 | Master 2 - Probability and Finance , Sorbonne University. |
| 2009-12 | École Polytechnique . |
| 2007-09 | Lycée Saint-Louis , preparatory classes in Mathematics-Physics. |

Research Projects, Grants, and Awards

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| 2026- | Scientific coordinator of the ANR JCJC project MATURE , <i>MAThematical models for Under-standing ageing in the wild and its Evolutionary role</i> . Funding: 358 000 euros, 2026-2030. |
| 2022-25 | Member of ANR DREAMeS Numerical methods for decision: Dynamic pREferences And Multi-variate riSkS. |
| 2022 - | Louis Bachelier Academic Fellow , Louis Bachelier Institute. |
| 2019- | Member of the Emerging or Atypical Risks in Insurance Research Initiative (Re2A) , between Le Mans University and COVEA-MMA. |
| 2019 | EIF Grant (Institut Europlace de Finance) for the project "Intergenerational Risk Sharing in Pension Plans" , with Jennifer Alonso Garcia, Caroline Hillairet, and Mohamed Mrad. |
| 2018 - | Member of the Chaire Modélisation Mathématiques et Biodiversité . |
| 2018 | - SCOR Actuarial Award for Young Doctor . |

Publications and Preprints

Preprints.....

- 2026 [Acute Smurf mortality and age-dependence in a two-phase ageing model](#), with L. Breuil, M. Doumic, and M. Rera, submitted.
- 2026 [Deep numerical schemes for systems of Ergodic BSDEs with applications to regime-switching forward utilities](#), with G. Broux-Quemerais, A. Matoussi, and W. Sabbagh.
- 2026 [Optimal investment and Pension policy in Pay-As-You-Go systems under forward utility and ageing population](#), with J. Alonso-Garcia, C. Hillairet, and M. Mrad, submitted.
- 2025 [Nonparametric hazard rate estimation with associated kernels and minimax bandwidth choice](#), with L. Breuil, in revision.

Publications.....

- 2025 [Efficient simulation of Individual-Based population Models: the R Package IBMPopSim](#), *Computo*, with D. Giorgi and V. Lemaire.
- 2024 [Deep learning scheme for forward utilities using ergodic BSDEs](#), *Probability, Uncertainty and Quantitative Risk*, with G. Broux-Quemerais, W. Sabbagh, and A. Matoussi.
- 2024 [Estimation of Systemic Shortfall Risk Measure using Stochastic Algorithms](#), *SIAM Journal on Financial Mathematics*, with A. Matoussi and A. Tamtalini.
- 2024 [Time-consistent pension policy with minimum guarantee and sustainability constraint](#), *Probability, Uncertainty and Quantitative Risk*, with C. Hillairet and M. Mrad.
- 2023 [Birth Death Swap population in random environment and aggregation with two timescales](#), *Stochastic Processes and their Applications*, with N. El Karoui.
- 2020 [Ethical and social implications of approaching death prediction in humans-when the biology of aging meets existential issues](#), *BMC Medical Ethics*, with M. Gaille, M. Araneda, C. Dubost, C. Guillermain, E. Ricadat, N. Todd, and M. Rera.
- 2019 [How can a cause-of-death reduction be compensated for by the population heterogeneity? A dynamic approach](#), *Insurance Mathematics and Economics*, with H. Labit-Hardy, S. Arnold(-Gaille) & N. El Karoui.

Software.....

- 2024 [Deep learning scheme for forward utilities using ergodic BSDEs \(GitHub\)](#), with G. Broux and W. Sabbagh.
- 2023 [Estimation of Systemic Shortfall Risk Measure using Stochastic Algorithms \(GitHub\)](#), with A. Tamtalini and A. Matoussi.
- 2021 [IBMPopSim: An R package for simulating stochastic Individual-Based Models](#), with D. Giorgi and V. Lemaire.

Specific Skills

Programming C++, R, Python.

Languages French (native), English (fluent), Arabic (intermediate).

Recent Research Presentations

Conferences

- 2026 - [IMS Annual Meeting](#) (Institute of Mathematical Statistics), Salzburg, *Crossing a fitness valley in age-structured populations*.
- [European Conference on Mathematical and Theoretical Biology](#), Graz, *Nonparametric hazard rate estimation with associated kernels: theory and application to a two-phase aging model*.
- [Stochastic Control and Games for Risk and Regulation](#), *Optimal Investment and Pension Policy in Pay-As-You-Go Systems under Forward Utility and ageing population*.
- [ARBRE 3](#) : GdR Branchement conference, Avignon.
- 2025 - [ANR DREAMeS closing conference](#), Institut des Systèmes Complexes, Paris.
- 2024 - [Conférence inaugurale RT MATRISK](#), Le Mans.
- [Stochastic Control and Games for Risk and Regulation 2024](#), Tunisie
- [European Actuarial Journal Conference](#), Lisbonne
- 2023 - [Financial Risks International Forum](#), Paris.

Invited Seminars and Working Groups.....

- 2026 - Séminaire de Probabilité, IRMA, Université de Strasbourg.
- Séminaire de Statistique, LMRS, Université de Rouen.
- Workshop de la chaire Modélisation Mathématiques et Biodiversité, CMAP, Ecole Polytechnique.
- 2025 - Séminaire Probabilités et Statistique, Laboratoire Paul Painlevé, Université de Lille.
- Groupe de travail Modélisation Aléatoire du Vivant, LPSM, Sorbonne Université.
- 2024 - Séminaire Mathématiques pour la Biologie et les Images, LAGA, Université Sorbonne Paris Nord.
- Séminaire Parisien de Statistique, IHP, Paris.
- [Mathematical Modeling Seminar in Life and Health Sciences](#), LJLL, LAGA, and MAP5, Paris.
- [Bachelier Seminar](#), Henri Poincaré Institute.
- Probability Seminar, CMAP, Ecole Polytechnique.

Seminars and Conferences Organized

- 12/2026 **First workshop of the ANR Mature project**, Université Sorbonne Paris Nord.
- 2024 - [Seminar of the MBI team](#), LAGA, Université Sorbonne Paris Nord.
- 2025 **Workshop Decision in Pension and Risk Sharing**, Institut des systèmes complexes, Paris.
- 2020-22 **Co-organization of the [Re2A Research Initiative](#) Conferences.**
- 2019 **International Conference in Honor of Nicole El Karoui's 75th Birthday**, Sorbonne University.
- 2015-18 **Co-organizer of the [Longevity Working Group](#)**, LPMA and ANR [LoLitA](#).
- 2016 **Co-organizer of the LPMA Annual Conference**, University Paris VI.
- 2015 **"Modeling Causes of Death in Population Dynamics" Workshop**. Closing conference of the [PHC Germaine de Staël](#) project.
- 2014-15 **Co-organizer of the LPMA PhD Student Working Group**, University Paris VI.

Public Engagement and Outreach Activities

- 2025 **Participation in a gender-equality workshop aimed at women students.**
- 2024 **Participation to girls and Mathematics Day**, Le Mans Université.
- 2023 **Public Lecture**, Lycée Bellevue, Le Mans.
- 2019 - **Co-organization of the Girls and Mathematics Day**, November 10, 2019, LMM, Le Mans University.
 - **Participation in Researchers' Night**, September 27, 2019, Le Mans.
 - **Co-organization of the Women in Science Day**, Sorbonne University, May 21, 2019.
- 2015-17 **Lecturer for the "It's Likely" Project**, Paul Eluard Middle School and F93 Association, Montreuil (2x16h). Introduction to statistics and conducting a survey with a sociologist.
- 2014-15 **Scientific Outreach**, University Paris VI. Activities in primary schools.